

Homeostasis

* definition (keeping The internal environment (extracellular fluid) ECF)

* It nearly constant physically and chemically

Physically e.g. Volume - temperature - pressure

Chemically e.g. electrolytes - Nutrients - gases - pH - waste products

* Role of body system in Homeostasis

1. CVS is responsible for continuous renewal of ECF

2. Respiratory system supplies The ECF with O_2 From atmosphere and eliminate CO_2 From ECF to atmosphere

3. G.I.T supplies The ECF with nutrients and electrolytes

4. Urinary system remove water soluble waste products e.g. urea

5. Endocrine supplies The ECF with hormone

6. Skeletal system Bones provide and maintain normal Ca^{+} - phosphate and Mg^{+2} in ECF

7. Muscular system
↳ maintain homeostasis through moving The organism

8. Lymphatic system It helps in fat absorption and defends against infection

9. Integumentary system (skin) play role in maintaining internal environment

10. Nervous system It maintain by control and regulation

Feedback

+

-

Strength duration curve

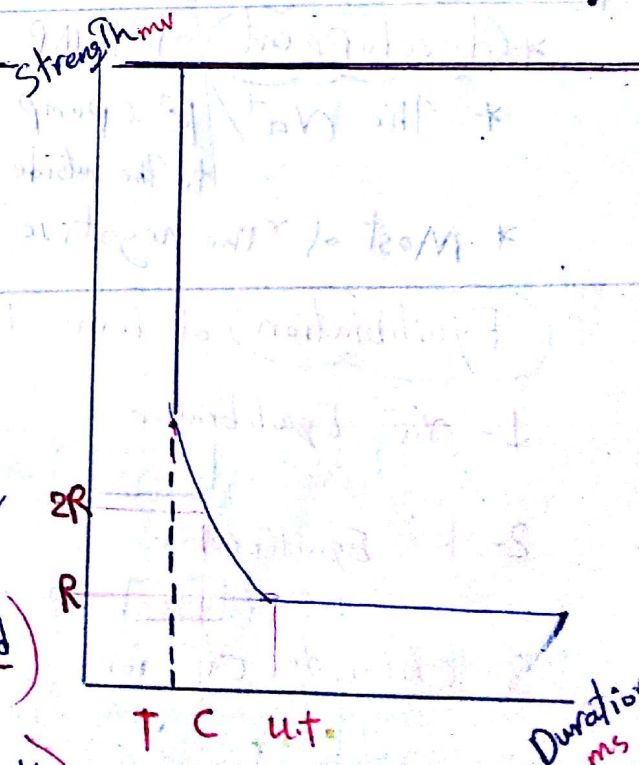
① The stronger is The stimulus.
The shorter is The time needed to excite and Vice Versa

② R (minimal intensity of current of very long Duration)

t (minimal duration required for stimulation)

U.T (It is time needed by The Threshold to stimulate)

C (It's time needed by double Threshold to stimulate)



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3 Resting membrane potential (RMP)

- * definition (It is potential of The cell membrane During rest (-70 mV))
- * The negative sign indicates The charge inside The nerve The predominates
- * Under normal condition all point on the surface and inside of nerve fiber is Isopotential

* Causes of RMP

① Na^+/K^+ pump

- (It is responsible for the original development of RMP)
- Function It transmits 3Na^+ ions to outside - 2K^+ ions to inside
- It is active process i.e. $\begin{cases} \text{requires ATP} \\ \text{enzyme } \text{Na}^+/\text{K}^+ \text{ - ATPase} \end{cases}$

② selective permeability

- (The RMP of nerve is 50/100 times more permeable K^+ than to Na^+)

Thus because

- ① Na^+ channels are closed while K^+ channels are opened
- ② Na^+ channels guarded by Ca^{+2} from outside
- ③ Both Na^+ and K^+ are surrounded by a jacket of water molecules

→ Non diffusible ions $\ominus$

- 1- Pr^-
- 2- Po_4^-
- 3- So_4^{-2}

* development of RMP

- * The Na^+/K^+ pump causes more transport of positive ions to the outside (3Na^+) than to the inside (2K^+)
- * Most of The negative ions inside nerve fiber are non diffusible

Equilibration of ionic Transport

1- Na^+ Equilibration

Na^+ is more concentration on The outer surface

2- K^+ Equilibration

K^+ is more concentration in The inside surface

3- Chloride Cl^- ions

No pump of Cl^- but They move by passive diffusion

4- Ca^{+2}

5- Mg^{+2}

→ [present inside nerve fiber]

4 Action potential

- definition (It is series of electric changes which accompany the nerve impulse)
- It is formed of
 - 1- Latent period
 - 2- spike potentials
 - 3- After potentials

→ The monophasic action potential
It is recorded by two microelectrodes connected to a CRO and placed at a distance from the stimulating electrodes

→ The following electric changes

1 The stimulus Artifact

(It is short period of irregular deflection of the base line of CRO at the moment of application of stimulus)

2 Latent period

(It is an isopotential period following the stimulus artifact) Then occur Depolarization

3 Firing level

(It is the membrane potential at which the rate of depolarization changes from gradual to rapid form -55 mV)

4 Reversal polarity

(The membrane rapidly depolarizes to reach zero potential then continues to positive direction $+35 \text{ mV}$)

5 Repolarization

(The membrane starts to fall back again to resting level)

3-4-5 steps called spike potential

i.e. (It is the rapid depolarization followed by the rapid re-

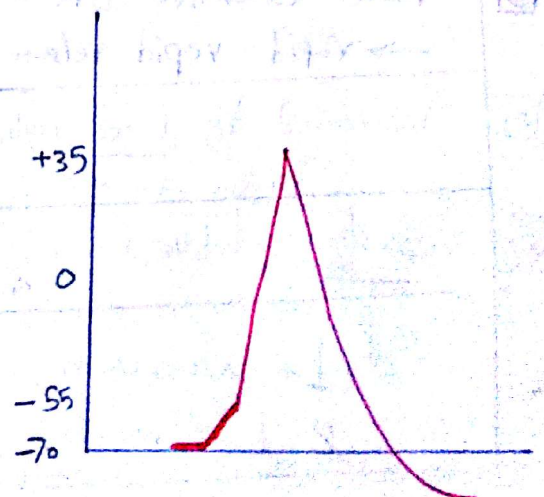
After potential

(A) Negative

is the slower repolarization at the end of repolarization

(B) Positive

The membrane potential becomes more than -70 mV



→ It is ionic **A-P**

resting **dep**
 ↑ Na^+ influx
 ↑ K^+ outflux
 Na^+ outside
 K^+ inside

Firing level **re**
 ↑↑ Na^+ influx
 ↓↓ K^+ outflux

After
 ⊖ K^+ in
 ⊕ Na^+ out
 ↑↑↑
 ↑↑↑

5 Excitability changes During action potential

1 ARP

- * excitability is completely lost
- * no stimulus can stimulate site
- * ascending to early part of descending

2 RRR

- * It is starting to return to normal
- * strong stimulus needed to excite
- * to lost 2/3 of the descending

3 supernormal phase

- * excitability is greater than normal
- * subthreshold can stimulate site
- * to negative after potential

4 subnormal phase

- * It is less than normal
- * strong stimulus needed to excite
- * to positive after potential

6 Type of muscle fiber ↗ red ↘ pale

	pale fiber (white)	red fiber
1	Contain Less Myoglobin-blood flow	more
2	Contain Less Mitochondria	more
3	have Fast myosin ATPase activity → Fast contraction	slow
4	have short twitch duration i.e. rapid	have long duration i.e. slow
5	more extensive SR → rapid repid release Ca^{+2}	slow
6	innervated by large myelinated motor neuron	innervated by small myelinated motor neuron
7	easy fatigued	Resist fatigue
	e.g. 1- extraocular 2- hand muscles	e.g. large muscles of the back

7 Type of nerve impulse Conduction 5

① Conduction In Nonmyelinated nerve fiber

- When The adequate stimulus is applied — We get reversal of polarity at The site of stimulation
- The outer surface becomes negative (cathode)
- The positive charges from membrane in front of and behind (The area of reversal of polarity) will be drawn into it.

* in this Conduction

→ The impulse is conducted as a wave of reversal of polarity

② Conduction In myelinated nerve fiber

- The myelin sheath is electric insulator
- The adequate stimulus produces reversal of polarity at The active node of Ranvier.
- The positive charge on The outer surface of The next node of Ranvier jumps into The active node.
- The jumping of depolarization from node to node is called saltatory conduction

* This Conduction

→ It is rapid → Consumes less energy

8 Mechanism of muscle contraction

① Discharge of motor neuron and arrival of nerve impulse to motor end plate

② Depolarization of The nerve terminal allow entry of Ca^{+2}

③ Generation of End plate potential

- * ACh cross The gap between nerve and muscle
- * and It bind to receptor on The surface of The muscle
- * Na^{+2} enters inside of muscle fiber

④ release of Ca^{+2} from The sarcotubular system and It binds strongly with troponin

⑤ role of Ca^{+2}

- ↓
- * During relaxation of The muscle troponin I is tightly bound to actin
- * Tropomyosin cover The active sites on actin
- * when Ca^{+2} bind to troponin C tropomyosin moves laterally from actin exposing Its active sites

⑥ Formation of Cross bridge between actin and myosin

N.B Both Contraction and Relaxation need energy $ATP \xrightarrow{ATPase} ADP + P_i$

⑦ Relaxation
 * Ca^{2+} is pumped back into The sarcoplasmic reticulum by active pump $Ca^{+2}-Mg^{+2}$ ATPase ①

9 Type of muscle contraction

	isotonic	isometric
① shortening	muscle shortens	No change in length
② Tension	No change in tension	increase in tension
③ work	Work	Zero
④ energy	High	very low
example	biceps lifting and carrying a weight against gravity	No movement no carrying weight

10 Myasthenia gravis and Fatigue

→ It is a hereditary disease That affects females more than males
 → It is characterized by marked progressive weakness and easy fatigability of muscles
 → It is due to formation of Auto-antibodies That lead to

① Destruction of A-ch receptor at The MEP

② Destruction of Ca^{2+} channels at MEP

→ It is treated by drugs which inhibit cholinesterase e.g. protigmine

Fatigue

* definition (temporary ↓ decrease of work capacity of muscle)
Caused by work itself

* Causes of fatigue

① when The muscle is stimulated indirectly through Its nerve

② when The muscle is stimulated directly • fatigue occurs due to ↓ depletion of The energy sources e.g ATP - glycogen

③ In The intact body fatigue occurs due to Failure of synaptic transmission in CNS

* evidence That fatigue occurs in MEP

early than in muscle itself =

- 1) A muscle is repeatedly stimulated through its nerve till development of
- 2) The electrodes are rapidly transferred to stimulate the fatigued muscle.
- 3) The strenght of muscle contraction is regained indicating.
- 4) If the muscle is repeatedly stimulated directly afterwards.

II Metabolic changes During muscle contraction



Significance

- 1) It is anaerobic
- 2) It provides the immediate source of energy for contraction

② Regeneration of ATP from ADP in presence creatin phosphate

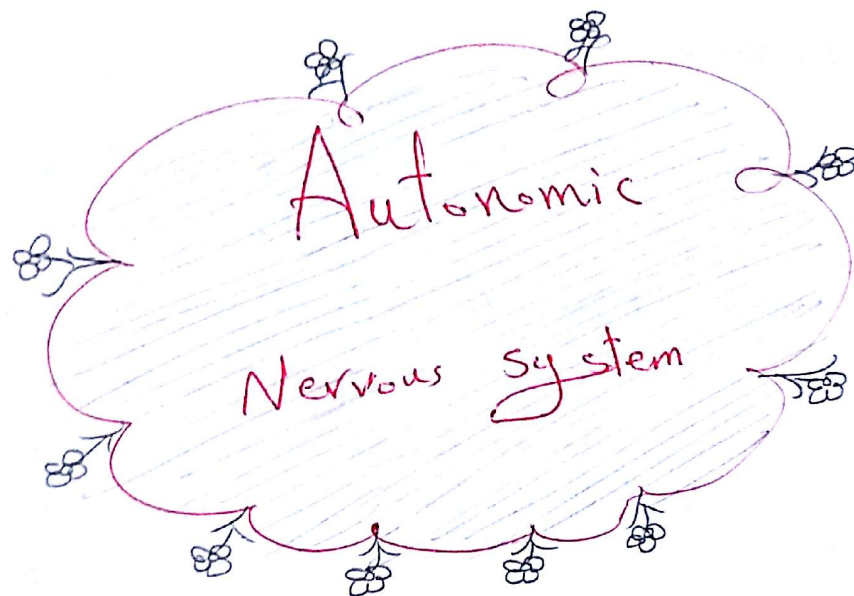


③ Resynthesis of creatine phosphate in presence high energy by breakdown and oxidation of glycogen

④ Free fatty acids and ketone bodies can be oxidized in the muscle to provide energy

(N.B) Energy is store in form ATP

ما کتبہ فرود ایس پی



6 questions

I Autonomic Ganglia

1

* definition collection of nerve cells outside The C.N.S

* types

① Lateral ganglia

→ These ganglia are The main sites for relay of

→ It forms ② ^{Sympathetic only} sympathetic chain on each side of The

→ Each chain extends ^{Vertebral column} from The base of The skull to coccyx
It contain ②3 ganglia

② Collateral ganglia

→ These ganglia are sympathetic ganglia only

→ These are the origin of big arteries arising from The abdominal aorta

③ Terminal ganglia

→ These ganglia are parasympathetic only

→ present near or in wall of visceral organs

* Function

1- Distributing centre

2- mother cell for certain local Axon Reflexes

* Determination of The site of Relay
in Autonomic ganglia

→ If gives a postganglionic response → These fiber don't relay

→ If no response → do relay

2 Sympathetic supply to Head and Neck and Horner syndrome

* Origin and Relay

→ preganglionic fiber arise from The L-H-Cs of The upper 2 Thoracic segment

→ Relay in The superior cervical sympathetic ganglion

→ postganglionic fiber pass along The branches of Carotid arteries

* function

1 eye

- 1- dilatation of pupil
- 2- lid retraction
- 3- exophthalmos
- 4- Vaso Constrictor to blood vessels of the eye
- 5 relaxation of ciliary muscle

2 Salivary glands

- 1- Trophic secretion
- 2- Squeeze saliva
- 3- Vaso constrictor to salivary blood vessels

3 Skin

- 1- sweating
- 2- erection of hair
- 3- Vasoconstrictor to cutaneous blood vessels

4 brain

(Vasoconstrictor to cerebral blood vessels)

* Horner's syndrome (group of signs caused by injury of cervical sympathetic chain)

- 1- ptosis drooping of upper eyelid due to paralysis of superior tarsal muscle
- 2- Miosis Constriction of the pupil due to paralysis of dilator pupillare
- 3- Anhidrosis dryness of skin due to paralysis of sweat gland
- 4- Enophthalmos backward retraction of eyeball in the orbit It is false man
- 5 Vasodilatation due to loss of sympathetic vasoconstrictor tone
The skin become red - warm

3 Greater splanic Nerve and Lesser

* origin and relay

- pre arise from L.H.Cs of lower 6 Thoracic segment
- Relay Coeliac and Superior mesenteric Collateral ganglia
- post reach abdominal viscera along their Blood Vessels

* function

- 1 Splanchnic vessels Vasoconstriction to stomach - small intestine
- 2 GIT * relaxation of their wall and motor to their sphincter
* Inhibition of gastric and intestinal secretion motility

- 3 Gall bladder inhibitory of wall but motor to sphincter
- 4 Liver stimulates glycogenolysis $\rightarrow$ $\uparrow$ blood glucose level
- 5 spleen squeeze stored blood due to motor to smooth muscle
- 6 Pancreas inhibits insulin hormone
- 7 Kidney 1- Vas. constrictor to renal vessels
2- Stimulates renin secretion
- 8 Adrenal Medulla stimulates the secretion of Adrenaline (80%) nor (20%)

* Lesser Splanchnic Nerve

* origin and Relay

- $\rightarrow$ Pre arise from [L-H-Cs] of upper 3 lumbar segments
- $\rightarrow$ relay inferior mesenteric collateral ganglia
- $\rightarrow$ Post pass along B-Vs to supply the pelvic viscera

* Function

- 1- retention of urine in urinary bladder
- 2- retention of faeces in Distal Colon and Rectum
- 3- Ejaculation of semen
- 4- V-C to B-Vs of pelvic viscera
- 5- V-C to B-Vs of external genital organs

4 III - VII - IX - Vagus nerve

III Oculomotor Nerve

- * origin and relay
 - Pre mid brain
 - Relay ciliary ganglion
 - Post supply pupillary and ciliary muscle

* Function

- 1- constriction of pupil $\rightarrow$ due to motor to Pupillae muscle
- 2- motor to ciliary muscle

• If cutting of oculomotor Nerve

- 1 Mydriasis
- 2 loss of accommodation of eye for vision
- 3 lateral squint
- 4 ptosis

VII Facial Nerve

* origin and relay

- Pre $\rightarrow$ Chorda tympani
- Relay $\rightarrow$ Submandibular ganglion
- Post $\rightarrow$ Submandibular and sublingual gland

2) pre → other fibers of chorda tympani

3) pre → greater superficial petrosal nerve

(relay) → terminal ganglia in tongue

(post) → supply to tongue vessels

(relay) → sphenopalatine

(post) → supply to nasopharynx

* function

1- secretory and V-D to The submandibular

2- V-D to anterior 2/3 of The tongue

3- secretory and V-D to nasopharynx and lacrimal gland

IX Glossopharyngeal nerve

* origin and relay

pre upper part of medulla oblongata

relay otic ganglion

post reach The parotid gland

* function

1- Secretory True Secretion and V-D to parotid gland

2- V-D to Posterior 1/3 of The tongue

Vagus nerve

10th

* origin and relay

→ pre arise from vagus nucleus in M.O

→ relay in terminal ganglia

→ post supply Thoracic and abdominal viscera

* function

↓
Thorax

1 Heart

1- inhibition of all properties of atrial muscle

2- ↓ Heart rate

3- V-C of coronary blood vessels

4- ↓ O₂ consumption of The heart

2 lung

1- bronchoconstriction

2- secretory to bronchial gland

3- V-D to pulmonary B-Vs

↓
Abdominal

1 GIT

motor to wall → inhibit to sphincter

2 Gall bladder evacuation of gall bladder

3 Gland secretion of All gland in Abdomen

4 V-D to gastric blood vessels

5

Site of release A-ch

5

Acetyl choline Formed and released at The ending of
of cholinergic nerve fibers

(A) Central cholinergic sites

- 1- At all pre ganglionic Para and Sym — nerve ending both
i.e. all autonomic ganglia
- 2- At pre ganglionic Sym — nerve ending
i.e. adrenal medulla
- 3- At somatic motor nerve ending

(B) Peripheral cholinergic sites

- 1- At all post ganglionic Para — nerve ending
- 2- At post ganglionic Sympathetic nerve ending to eocrine
(Sweet glands and blood vessels of S-m)

6

Compare between adrenalin and Nor ☺ α and β receptor

according to	adrenalin	Nor - adrenalin
1 Structure	has Methyl group	hasn't
2 site	* adrenal medulla * As chemical transmitter in Cns	* Adrenal medulla and Cns * At postganglionic sym — nerve ending
3 stimulation	→ stimulates α - β equally → stronger than nor-adrenalin on β	→ stimulates α more than β → stronger than adrenalin on α
4 actions	* H-rate ↑ * Cardiac output ↑ * total peripheral resistant ↓ * Diastolic BP ↓	↓ ↑
	* systolic BP ↑ * intestinal motility ↓	Same Same
5 Fate	mainly methylated by COMT	mainly reuptake by adrenergic nerve ending

according	para	SmyP
1 action	α receptor mainly Excitatory of Smooth muscle	β receptor mainly inhibitory of Smooth muscle
2 Type	$\alpha_1 - \alpha_2$	$\beta_1 - \beta_2$
3 mechanism of action	$\uparrow$ intracellular Ca^{+2} $\downarrow$ intracellular cAMP	$\uparrow$ intracellular cAMP $\downarrow$
4 Stimulants	adrenalin Nor phenylephrine	adrenalin Nor Isoproterenol
5 Blockers	Phentolamine	Propranolol